



Fermi

Gamma-ray Space Telescope



The Galactic Center Source as seen by Fermi

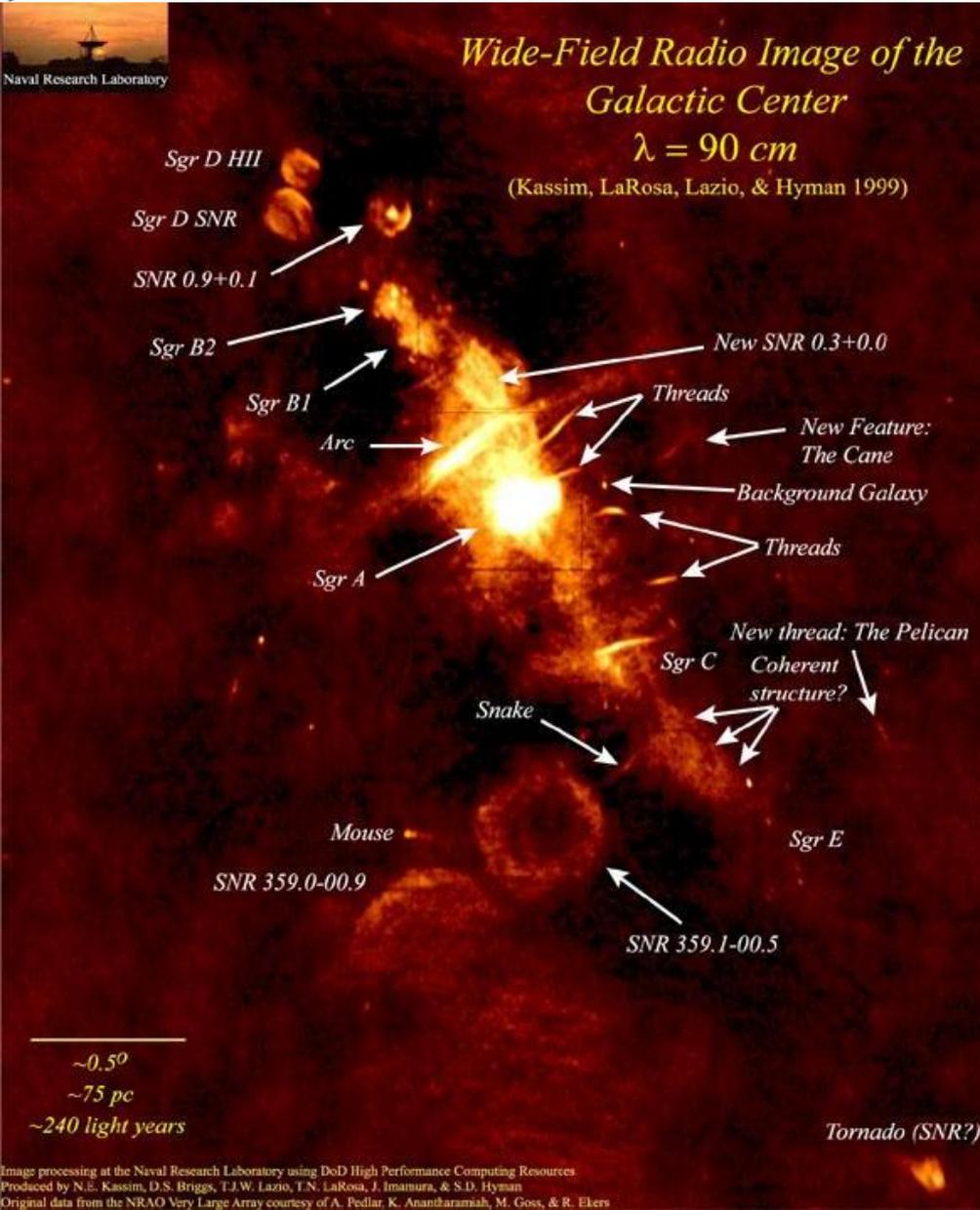
Johann Cohen-Tanugi

(LPTA/CNRS and University Montpellier 2)

on behalf of the
Fermi Large Area Telescope
Collaboration

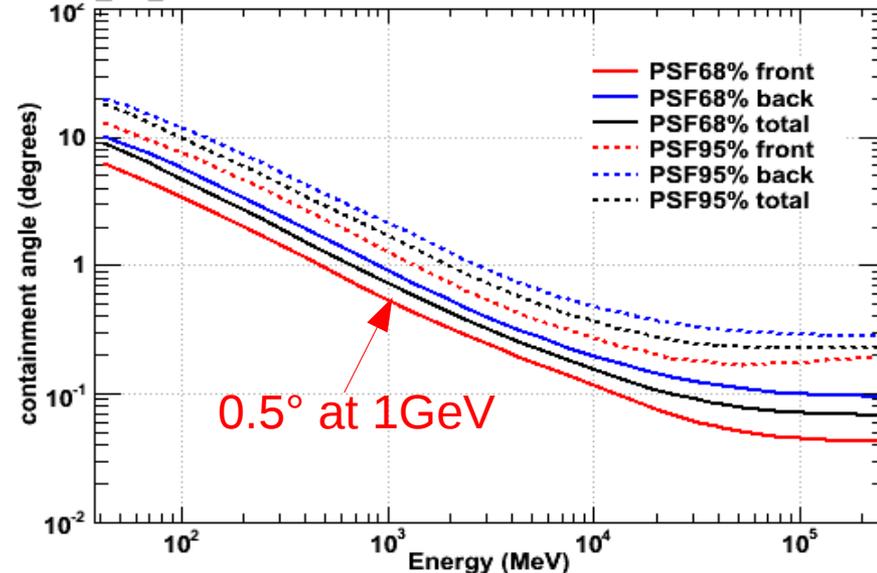
2009 Fermi Symposium

Hell's Kitchen



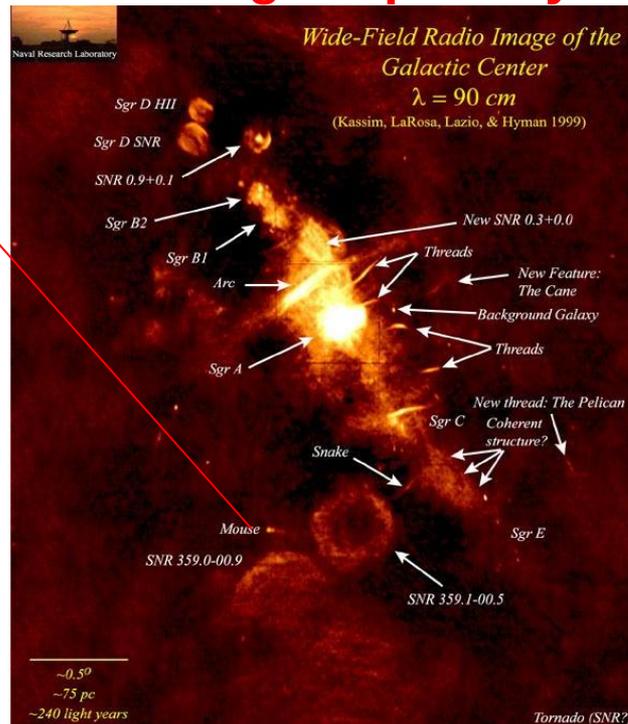
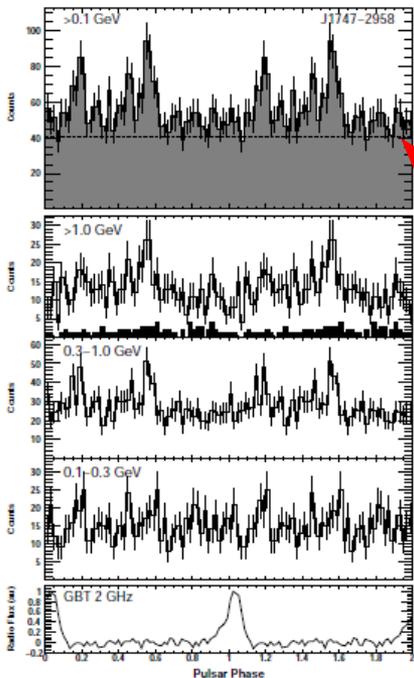
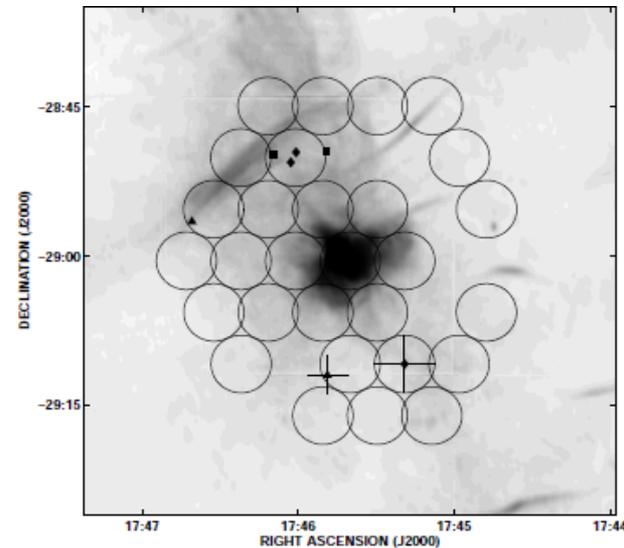
- One of the most complex regions in the sky!
- A huge pp emissivity due to CRs streaming through very dense clouds (CMZ)
- Electrons too (IC with local ISRF)
- Many possible γ -ray emitters (SNR, pulsars, binaries....)

PSF P6_V3_DIFFUSE for normal incidence



Local Source classes of possible interest

- **Deneva et al. 09** : 3 pulsars detected in the close vicinity of SgrA*. **Inferred population of ~2000 active radio pulsars!**
- 2 famous star clusters (Arches and Quintuplet)
- LMXBs around (see e.g. Del Santo et al. 2006)
- SNRs and PWNs (see e.g. Johnson et al. 2009)
- **GAS! Discussed in Seth Digel's plenary talk**



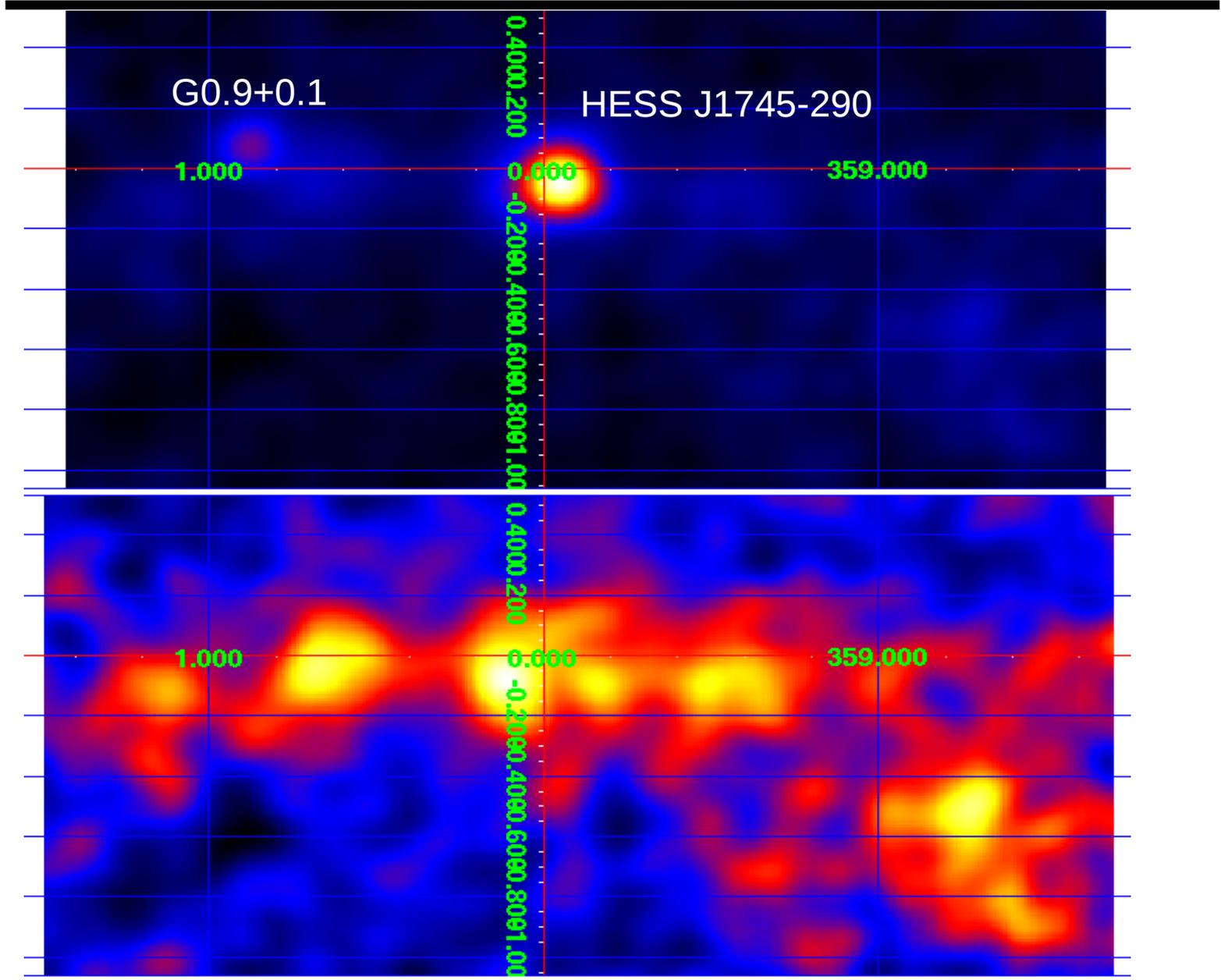
Mouse pulsar PSR J1747-2958 detected in γ -rays!

**Abdo et al. 09, submitted to ApJ
arxiv:0910.1608**

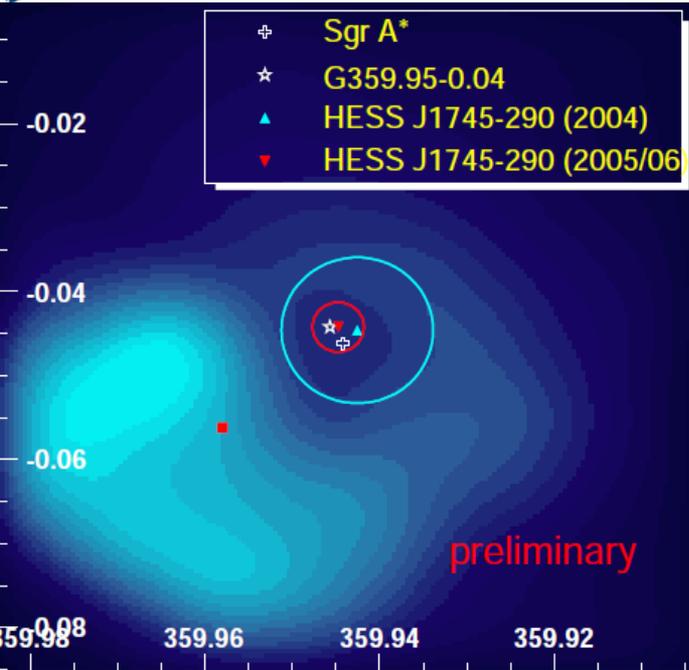
Fig. A-31.— Light curves for PSR J1747-2958 ($P = 98.8$ ms).

Image processing at the Naval Research Laboratory using DoD High Performance Computing Resources
Processed by N. E. Kassim, D. S. Britton, L. W. Lazio, T. N. Little, J. Jimenez, & A. D. Hyman
Original data from the NRAO Very Large Array courtesy of A. Pedlar, K. Anantharaman, M. Goss, & R. Ekers

H.E.S.S. view of the GC



Recent H.E.S.S. results



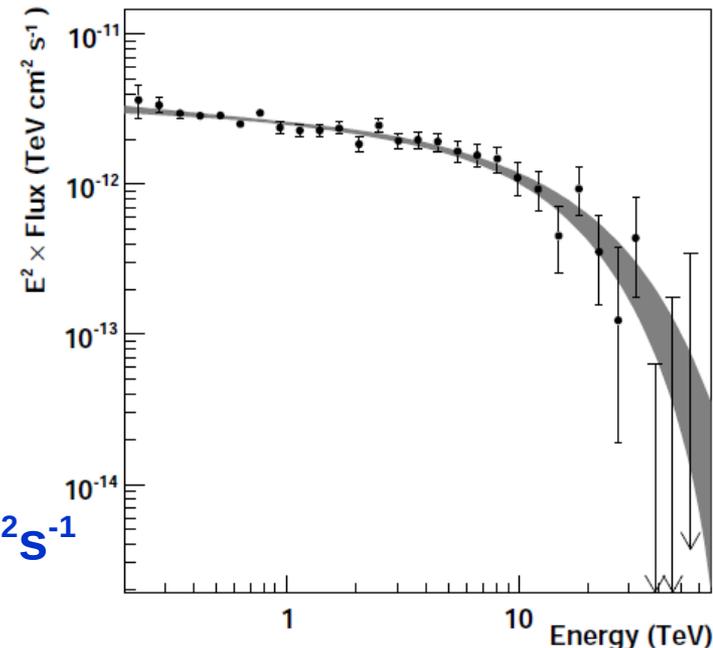
- Van Eldik et al. 2007
 - Improved pointing analysis : 30" → 6"
 - Sgr A East excluded at 95% C.L.
- Remaining candidates
 - SgrA*
 - PWN cand. G359.95-0.04 (Wang et al. 06)
 - others....

- Aharonian et al. 2009
 - 3 year analysis shows cutoff
 - No variability found

$$\frac{dN}{dE} = \Phi_0 \times \left(\frac{E}{1\text{TeV}} \right)^{-\Gamma} \times e^{-\left(\frac{E}{E_{\text{cut}}} \right)}$$

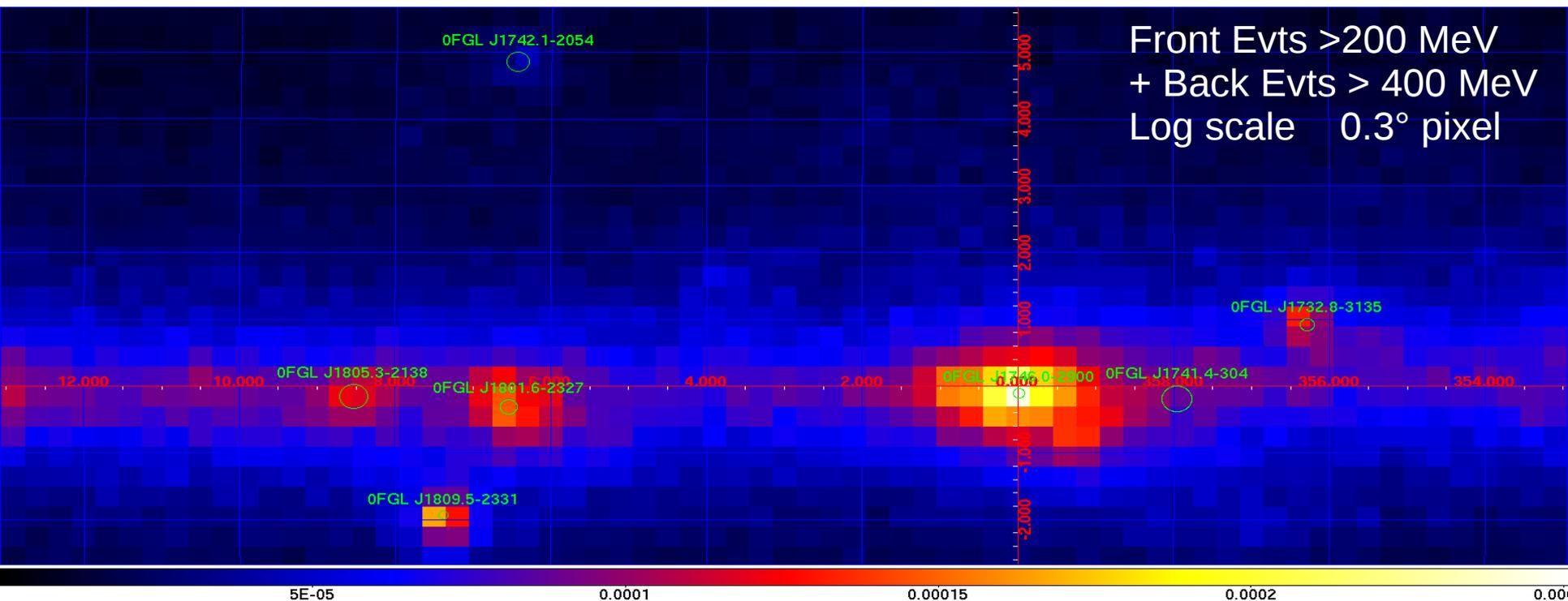
- $E_{\text{cut}} \sim 20\text{TeV}$ $\Phi_0 = (2.55 \pm 0.06) e^{-12} \text{ TeV}^{-1} \text{ cm}^{-2} \text{ s}^{-1}$

- $\Gamma = 2.1 \pm 0.04$

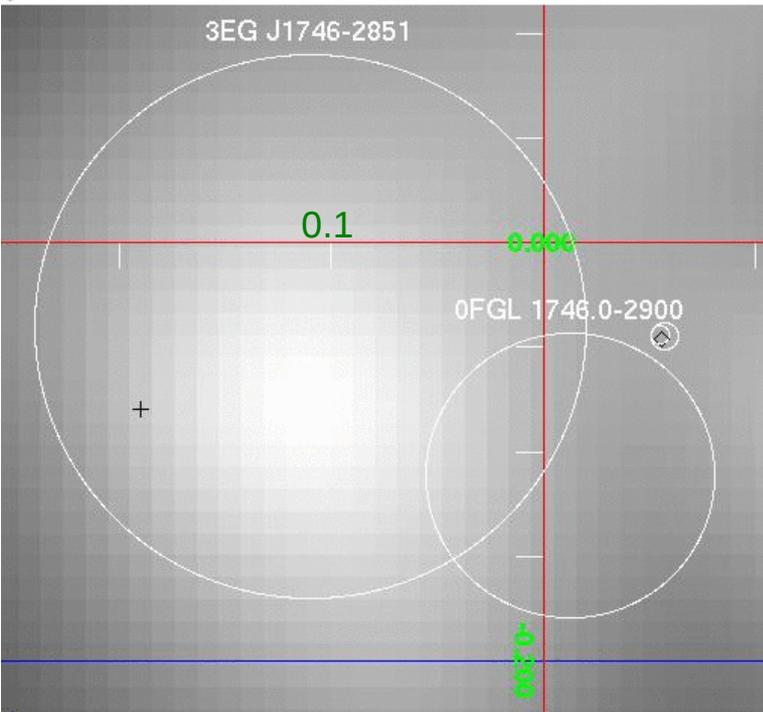


The LAT BSL sources within 10° of the GC

- **Bright Source List (BSL):** 3 month LAT catalog of highly significant sources ($TS > 100$) : [Abdo et al., ApJS 183, 46-66, 2009](#)
- 9 month skymap in cts/s/pixel with 95% C.L. error circles for BSL sources (0.3° pixel)
- We are contemplating a vastly more inhabited landscape after 11 mths and $TS > 25$...
- **0FGLJ1746.0-2900 detected at 36σ , position=(266.506, -29.005, 0.068)**



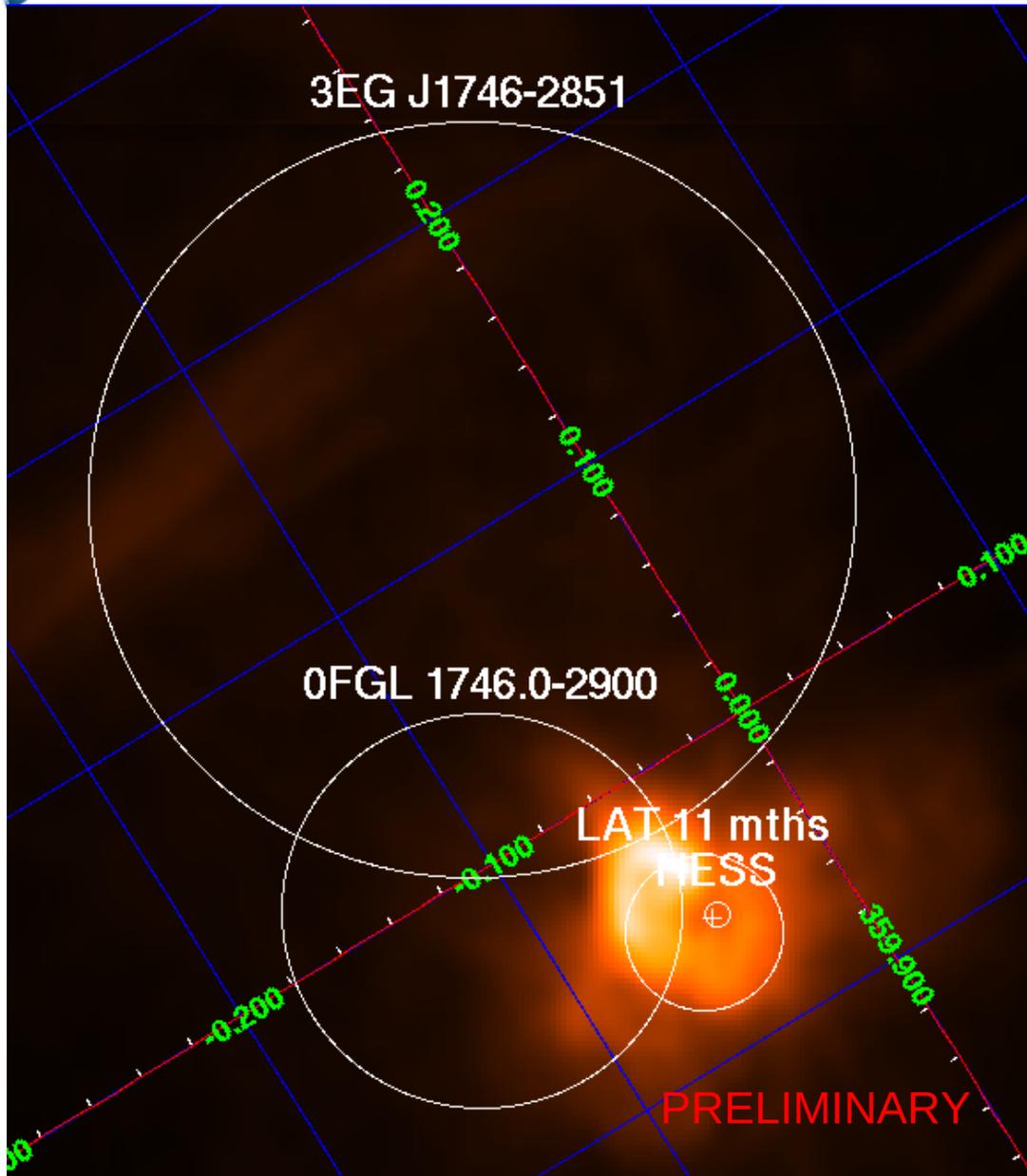
Localization and variability of the BSL source



- Image is H.E.S.S. after source removal
- Diamond is SgrA*, with the 2 most recent H.E.S.S. Localizations
- **Formally inconsistent** with the BSL position
- EGRET reanalysis (Dingus&Hooper 04) not consistent either with BSL!
- Still need more data to understand systematic biases....

- Variability studies in the BSL paper finds **marginal variability**
 - Chi2 based, PWL flux (200MeV to 100GeV) computed per week
 - Threshold=24.7, (alpha error=1% ~ 2 false positives in the 205 BSL sources)
 - Key to association and interpretation of the GC source (think DM....)

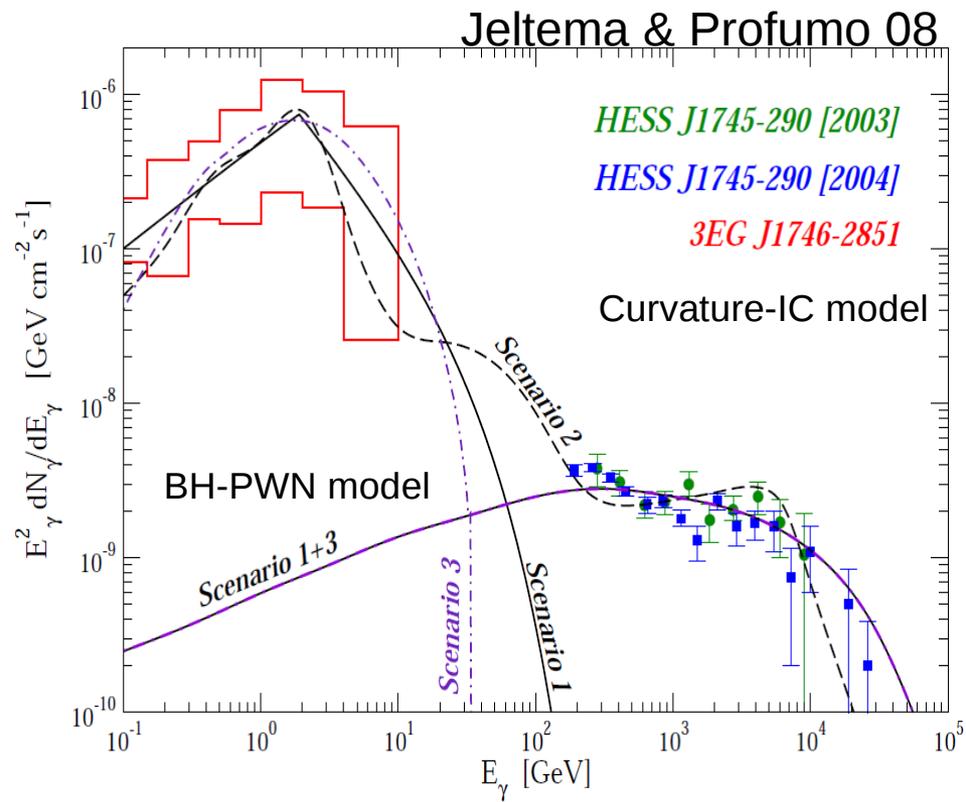
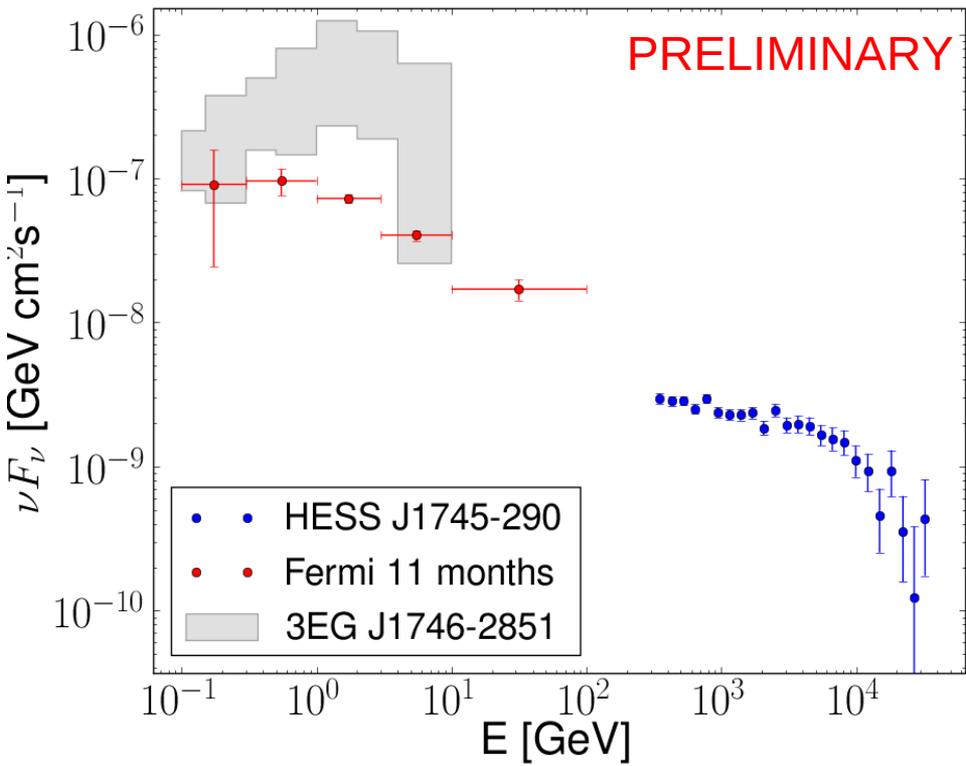
11 month localization



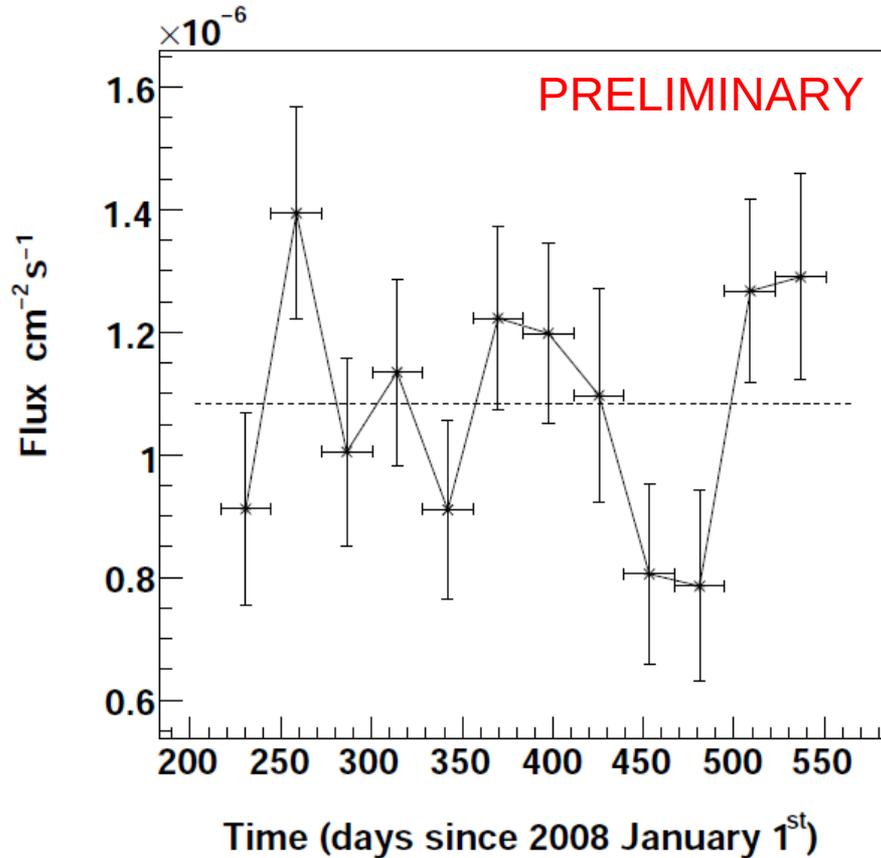
- La Rosa et al. 90cm radio map
- Cross : SgrA*
- 11 month error is 95% C.L. With 1.2 scale factor and 27" systematics added in quadrature
- **11 month analysis does not confirm the BSL result : H.E.S.S. and LAT sources are spatially coincident**
- SgrA East is not excluded by the LAT, but not favored either.

Preliminary Spectral considerations

- **11 month LAT flux significantly lower than EGRET analysis** (Mayer-Hasselwander)
 - Weak evidence for a SED peak below 1 GeV
 - Harder spectrum than previously modeled
- **Matching H.E.S.S. Spectrum (single source hypothesis) requires**
 - Either a high-energy break
 - Or a cutoff..... under study



Source Variability



- Integrated flux from 100 MeV to 100 GeV
- Dashed line is the 11 month average
- BSL Mentioned possible marginal variability
 - Not confirmed, within errors, on a ~monthly scale by 11 month LAT data
- Further analysis ongoing

Summary of Status

- LAT analysis ongoing in this very difficult region of the sky
 - Improved modeling of the background
 - Checks for systematics
 - Robustness of the analysis against possible unresolved sources, imperfect description of the gas distribution, etc...
- **Preliminary** features of the central bright excess emission
 - Compatible with a point source, in positional coincidence with the H.E.S.S. source (but still large error radius)
 - Flux somewhat lower than EGRET, with no obvious break above 1 GeV, and no variability over monthly scale
- APJL in preparation within the LAT collaboration

Dark Matter

- Galactic center is well-known as a potential source of gamma-rays related to decay of dark-matter particles
- See poster by Vincenzo Vitale
- For the LAT data, we need a very accurate background model to assess upper limits, and a very strong case to discard other possible astrophysical sources in case of detection....
- especially now that the 'GeV excess' is not there anymore:

